Spanish Fork High School 2014-15
Unit Topics and I Can Statements
AP Chemistry

Properties of Elements

- I can describe how mass spectroscopy works and use analysis of elements to calculate the atomic mass of an element
- I can calculate the energy, frequency, or wavelength of a photon of light
- I can relate an absorption or emission spectra to the atomic or molecular structure of a substance
- I can write electron configurations for ground state ions or atoms
- I can draw appropriate orbital diagrams for an atom correctly obeying Hund's rule; indicate what is meant by the term paramagnetism, and indicate if an atom will be paramagnetic
- I can identify discrepancies with Bohr's model of the atom and use principle of the wave-particle duality of electrons and the Heisenberg Uncertainty principle to account for these observations
- I can describe the importance of the photoelectric effect and apply it to photoelectron spectroscopy
- I can classify an element into the correct family based on its position on the periodic table or properties
- I can relate Coulomb's law to compare the atomic radius or ionization energy in atoms and ions

Properties of Compounds

- I can predict the type of bonding (ionic, metallic, molecular covalent, or network covalent) based on the positions of elements on the periodic table or properties of the compound
- I can use Coulomb's law to compare the melting point of two ionic compounds
- I can relate the properties of metals to the loosely held valence electrons in their structures
- I can relate the properties of network covalent compounds to their bonding structure
- I can draw appropriate Lewis structures for covalent compound
- I can compare the relative strength of a covalent bond based on its length and bond order
- I can indicate the number of sigma and pi bonds in a covalent compound
- I can indicate the hybridization (sp, sp2, or sp3) of an atom in a covalent bond
- I can predict the 3d shape around an atom in a covalent compound using VSEPR theory
- I can identify the intermolecular forces (London dispersion, dipole-dipole, and hydrogen bonding)

- I can compare the properties of covalent compounds (melting point, boiling point, physical state at room temperature, vapor pressure, solubility in water, etc) based on the strength of their attractive forces
- I can use formal charge to indicate which resonance structure(s) provide the best model for a compound.

Behavior of Gases

- I can convert between various units of pressure, volume, and temperature
- I can relate the temperature (in Kelvin) to the average kinetic energy of particles in a gas sample
- I can identify conditions when a gas does not act like an "ideal" gas and give reasons for this behavior in terms of intermolecular forces
- I can give the relationship between temperature, pressure, and volume of a sample of gas or use the ideal gas law to calculate one of these quantities
- I can describe how equal moles of any gas at the same temperature and pressure will occupy the same volume; use this to determine the stoichiometric relationship of gases in a reaction
- I can find the molar mass of a gas based on its density
- I can describe what is meant by and calculate the partial pressure of a sample of gas; give the relationship between mole fraction and partial pressure.

Writing Reactions

- I can write correct formulas for ionic compounds, acids, and binary covalent compounds
- I can predict the solubility of an ionic compound and the ionization of acids in water
- I can predict the products of synthesis, decomposition, single replacement, double replacement, combustion, and acid formation in water reactions
- I can write a balanced net-ionic equation
- I can give evidence of an observed chemical change or predict evidence for a chemical change.

Stoichiometry in Compounds and Reactions

- I can correctly report or round a measurement to the correct number of significant figures
- I can perform calculations reporting answers to the correct number of significant figures
- I can indicate the correct laboratory tool to use given the desired accuracy (or desired number of significant figures)
- I can use a mole map to convert between moles, particles, volume of gas, volume of liquid, or mass of a substance involved in a chemical reaction
- I can identify the limiting and excess reactants in a chemical reaction; use this to find the theoretical yield and percent error

- I can find the empirical formula of a compound given % composition, reaction data, or elemental or hydrate analysis data; use the molecular mass to find the molecular formula of the compound

Energy Changes

- I can trace the conversion of energy between various forms of kinetic energy, potential energy, and work
- I can describe how vapor pressure changes with temperature and describe normal boiling point
- I can interpret a heating or cooling curve, indicating the state(s) present in each portion of the curve and the energy involved in each phase change
- I can label a reaction as endothermic or exothermic; use ΔH to calculate the amount of energy involved when a given amount of substance reacts
- I can calculate the change in enthalpy, ΔH, for a reaction given bond energies, heats of formation, or enthalpies of reactions with a common intermediate
- I can predict the sign (+/-) of ΔS for a reaction; calculate the change in entropy (ΔS) for a reaction given a table of standard entropies
- I can predict the sign (+/-) of or calculate ΔG for a reaction given ΔH and ΔS; relate ΔG to changes in temperature
- I can calculate ΔG˚ given a table of standard free energies
- I can relate the sign (+/-) of ΔG to the magnitude of the equilibrium constant, K.

Properties of Solutions

- I can compare the number of solute ions in solution for various solutes (ionic, covalent, weak acids, strong acids) at given concentrations
- I can indicate which solution would have a greater conductivity
- I can give the appropriate method for separating a given mixture and give the physical property by which each method works (i.e. chromatography, distillation, filtration, evaporation)
- I can describe how to make a solution of given concentration or calculate the concentration of a solution made from a solid solute or a more concentration stock solution
- I can describe how spectrophotometry works, indicate the optimal wavelength for analysis, and create a calibration curve to find the concentration of a solution

Reaction Kinetics

- I can give the rate of a reaction as the slope of a concentration vs. time curve or given the rate of reaction for another species in a balanced reaction
- I can indicate factors which will affect the reaction rate and relate these in terms of collision theory (i.e. frequency and energy of collisions)

- I can interpret a potential energy diagram (i.e.: activation energy, endothermic vs. exothermic, activated complex, number of steps in a multistep reaction, rate-determining step of a multistep reaction, effect of a catalyst)
- I can qualitatively determine the effect of changing the concentration of a reactant on the rate of a reaction given the overall rate law
- I can interpret a proposed mechanism (i.e.: catalyst, intermediate) and evaluate if the proposed mechanism is supported by the rate law determined in the laboratory (relationship between rate-determining step and rate law)
- I can find the order of each reactant and overall order of a reaction given initial rate data or graphical data
- I can calculate the value of the rate constant, k, and find its units using either the rate law or a linearized graph
- I can given the reaction order, calculate the concentration of a reactant after a given amount of time and analyze the effect of changing concentration on half-life

Equilibrium

- I can write an appropriate equilibrium expression (Kc or Kp) for various types of equilibriums; make qualitative predictions about the quantity of reactants and products given the magnitude of the equilibrium constant
- I can combine and manipulate chemical equilibriums with a common intermediate to find the value of the equilibrium constant of a different reaction
- I can identify when to use an ICE table or only an equilibrium expression and correctly use them to solve equilibrium problems
- I can use the reaction quotient, Q, to predict the direction a reaction will go to reach equilibrium
- I can predict the effects of changing the concentration (or pressure) of a reactant or product, temperature, pressure, or addition of a system at equilibrium (i.e.: Le Chatlier's Principle)
- I can write equilibrium reactions and expressions for salts dissolved in water
- I can calculate the solubility of a salt in pure water or a solution with a common ion
- I can predict whether a precipitate will form if two solutions are mixed or which salt will precipitate first in a mixture of ions in which another salt solution is added

Acid & Base Equilibrium

- I can identify Bronsted-Lowry acids, bases, conjugate acids, and conjugate bases
- describe how strong acids and bases behave differently in water; relate the strength of an acid to the strength of its conjugate base
- I can predict the approximate pH (<, >, or = 7) for a salt solution
- I can compare the relative concentration of various ions in an acid solution with a polyprotic acid

- I can calculate the equilibrium values of H+ (H3O+) and OH- and calculate the pH (or pOH) of a solution given any other one of these variables
- I can calculate the pH of a strong acid or base
- I can calculate the percent ionization of a weak acid or weak base
- I can describe the composition and function of a buffer
- I can identify when it is appropriate to use an ICE table (one type of weak substance present) or only the equilibrium expression (buffer with both weak acid and weak base present) for a weak acid/weak base equilibrium problem
- I can calculate the Ka for a weak acid given the Kb for its conjugate base (or vice versa)
- I can write neutralization reactions between acids and bases; calculate the amount of acid or base needed to reach the equivalence point
- I can identify which side of an weak acid / weak base neutralization reaction that reaches equilibrium is favored
- I can describe the pH curve of strong acid/strong base, weak acid/strong base, and weak base/strong acid titrations
- I can calculate the pH at various points throughout a titration (before any titrant is added, after some titrant is added, half-way to the equivalence point, at the equivalence point)
- I can choose an appropriate indicator for a titration

Electrochemistry

- I can assign oxidation numbers and use these to determine what got oxidized and what got reduced in a redox reaction
- I can indicate the number of electrons transferred in a redox reaction and use this to balance a redox reaction (using the half-reaction method)
- I can calculate the concentration of an ion present if titrated in a redox titration
- I can identify the major components of a Galvanic cell (battery) and the function of each (i.e.: anode, cathode, salt bridge, flow of electrons, electrodes)
- I can write electrolysis reactions for molten salts and salts in solution
- I can use stoichiometric relations and Faradays constant to calculate the mass of a metal that can be reduced by electroplating
- I can predict the +/- sign of ΔG of an Galvanic cell and electrolysis reactions
- I can compare the +/- sign to the magnitude of the equilibrium constant, K.